



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject:	INSPECTION AND CARE OF GENERAL	Date: 8/20/82	AC No: 91-59
	AVIATION AIRCRAFT EXHAUST	Initiated by: AWS-340	Change:
	SYSTEMS		

1. PURPOSE. This advisory circular (AC) emphasizes the safety hazards of poorly maintained single-engine aircraft exhaust systems (reciprocating powerplants) and highlights points at which exhaust system failures occur. Further, it provides information on the kind of problems to be expected and recommends the performance of ongoing preventive maintenance and maintenance by pilots and mechanics, respectively.

2. BACKGROUND. Malfunction or Defect Report, Federal Aviation Administration (FAA) Form 8010-4, submitted by aircraft owners/operators and maintenance personnel shows that there is an upward trend in exhaust system failures during the last 5 years.

a. Review of accident/incident reports reveal that there have been numerous fatalities and injuries to pilots and passengers as a result of powerplant exhaust system failures. Probable cause factors included:

- (1) Occupants became incapacitated due to carbon monoxide intoxication;
- (2) Engine malfunctions/failures;
- (3) Engine nacelle compartment fires;
- (4) A combination of the above.

b. In an effort to prevent these accidents/incidents, the FAA and the aircraft manufacturers have, over the years, taken various measures to reduce and/or eliminate these problems. For example, the FAA has issued several airworthiness directives (AD's) on certain make and model aircraft requiring specific maintenance and inspections to be performed on the exhaust system at specified time intervals.

3. RELATED READING MATERIAL. Several AC's have been published which contain important information to familiarize pilots/mechanics performing daily and preflight inspections, checks, and required or recommended maintenance.

a. These AC's include:

- (1) AC 20-106, Aircraft Inspection for the General Aviation Aircraft Owner (SN 050-007-00449-4).
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(2) AC 43.13-1A, Acceptable Methods, Techniques and Practices, Aircraft Inspection and Repair (SN 050-007-00461-3).

(3) AC 65-12A, Airframe and Powerplant Mechanics Powerplant Handbook (SN 050-007-00373-1).

(4) AC 20-32B, Carbon Monoxide (CO) Contamination in Aircraft - Detection and Prevention.

(5) AC 43-16, General Aviation Airworthiness Alerts.

(6) AC 43-12, Preventive Maintenance.

Note: With the exception of AC's 43-12, 43-16, and 20-32B, all AC's shown above are for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. AC 43-16 is available, by request, from the U.S. Department of Transportation, FAA Flight Standards National Field Office, AFO-500, P. O. Box 25082, Oklahoma City, Oklahoma 73125. Advisory Circular 43-16 is also available for review at any local FAA Flight Standards District Office and contains a compilation of aircraft service experience problems reported to the FAA on the Malfunction or Defect Report, FAA Form 8010-4. AC's 20-32B and 43-12 are available from the U.S. Department of Transportation, Publications Section, M-443.1, Washington, D.C. 20590.

b. Aircraft manufacturers publish service letters, information letters, service bulletins, and maintenance manuals which inform the aviation public on the recommended maintenance, preventive maintenance, and how to correct exhaust system problems.

4. SAFETY HAZARDS.

a. FAA's studies show that approximately 50 percent of exhaust system failures occurred in the exhaust gas-to-air heat exchanger, resulting in carbon monoxide gas entering the cabin through the aircraft heater. The presence of exhaust gases in the cabin may effect the general efficiency of the pilot by causing impaired mental alertness, judgment, and reasoning, all of which contribute to or cause this type of accident/incident.

b. Approximately 20 percent of exhaust system failures occurred in the exhaust stack pipes, manifolds, and tail pipes, introducing carbon monoxide gas, smoke, or fire into the cabin area.

c. Approximately 20 percent of engine partial power loss and power failures resulted from internal muffler failure. Sheet metal baffles and/or defusers usually break off inside the muffler and completely or partially block the escape of exhaust gases from the engine cylinders. The severity of the power loss is proportional to the extent of blockage.

5. EXHAUST FAILURES.

a. A primary reason for most exhaust system failures is inadequate and infrequent inspections/checks and the lack of routine and preventive maintenance between inspections. Exhaust systems deteriorate for the following reasons:

- (1) Engine operating temperatures.
- (2) Vibration which causes metal fatigue in areas of stress concentration and wear at joints or connections.
- (3) Engine backfiring and unburned fuel in the muffler.

Note: The above conditions begin to take effect the first hour of engine operation and deterioration progresses through the lifespan of the exhaust system components.

b. Indication of cracked or leaking exhaust systems can occur in any area of the system; however, the following are found to be the most prominent problem areas:

- (1) Exhaust manifold and stack fatigue failures usually occur at welded or clamp joints (e.g., exhaust stack flange, stack to manifold cross pipes, or muffler connections).
- (2) Muffler and heat-exchanger failures usually occur on the inner wall surface. A proper inspection can only be accomplished when the outer heat shield is removed. This inspection should be accomplished as recommended by the manufacturer or by a properly certificated mechanic or repair station.

6. INSPECTION/CHECK.

a. The owner/operator of an aircraft is made primarily responsible by Section 91.165 of the Federal Aviation Regulations (FAR) Part 91 to see that between required inspections (e.g., annual, progressive, and 100-hour inspections), defects are repaired as prescribed in FAR Part 43. In the interest of safety, owners/operators should perform daily preflight inspections which include a thorough visual external inspection/check of the exhaust system.

b. Because of the design of some aircraft cowlings, an engine exhaust system may not be easily inspected/checked as needed. It is necessary that the cowl(s) be removed at frequent intervals (hours of operations) to perform a detailed inspection/check. Manufacturers service bulletins, information letters, and maintenance manuals recommend when maintenance inspections/checks should be performed. Persons performing maintenance and preventive maintenance should have this information available to them. Use of a high-intensity light and telescoping, hinge-handle mirror is recommended to facilitate a good inspection/check.

c. Visually inspect/check, in detail, the following external components of the exhaust system:

- (1) Muffler and heat exchanger for general condition and leaks.

- (2) Leaking exhaust stack gaskets (blown gaskets).
- (3) Loose or broken clamp connections, attachments, and stacks.
- (4) Cracked or broken stacks and tail pipes.
- (5) Dented stacks.
- (6) Cracks adjacent to welded areas and stack bends.
- (7) Thinning of joint areas due to vibrational wear.
- (8) Metal pitting due to internal erosion by combustion products.
- (9) Turbo supercharger for:

(a) Improper installation, including misalignment of exhaust stacks, ball joints, and/or connections which results in abnormal wear.

(b) Supercharger assembly for cracks and wear.

(c) Oil reservoir for improper service.

Note: In addition to the above, the firewall seal(s) should be carefully inspected to assure that the exhaust gases will not enter the cabin area. The engine compartment should also be free of combustible material and oil to reduce the possibility of a fire hazard.

d. Exhaust leaks and/or cracks are indicated by a gray-white or sooty-black streak or discoloration of the heat interchanger jacket. When defects are suspected, they should be further inspected by a qualified person for a determination of whether it should be repaired or replaced. An excessive engine RPM drop noted during the application of carburetor heat is also an indication of a cracked or leaking heat exchanger. If the owner/operator has any questions on whether they can perform an inspection or repair, AC 43-12, Preventive Maintenance, should be reviewed and/or the local FAA District Office should be contacted for this information.

e. Any time exhaust fumes are detected in the cabin, immediately shut off the cabin heat control, open a fresh air vent, and land as soon as practical. A thorough inspection of the entire exhaust system should be conducted, especially the muffler and heat exchanger, in accordance with the manufacturer's recommendation. Repair, replacement, and inspection, must be recorded per FAR 43.9 and this record retained in accordance with FAR 91, Section 91.173.



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